Atari Gets Serious

Learn how a "game computer" such as the Atari can be used in a physics lab.

By Ted McFadden

Most people are aware that Atari computers can play quite a game of Star Raiders, but how many realize that they are also powerful educational tools?

I discovered the educational aspects of my machine shortly after I bought it. We had been working on simple harmonic motion (the oscillatory motion produced, for example, by a spring) in physics. The teacher was demonstrating what is called a Lissajous curve (see Fig. 1). The demonstration was impressive, but lacked the precision and control I felt a computer, like my Atari, could provide.

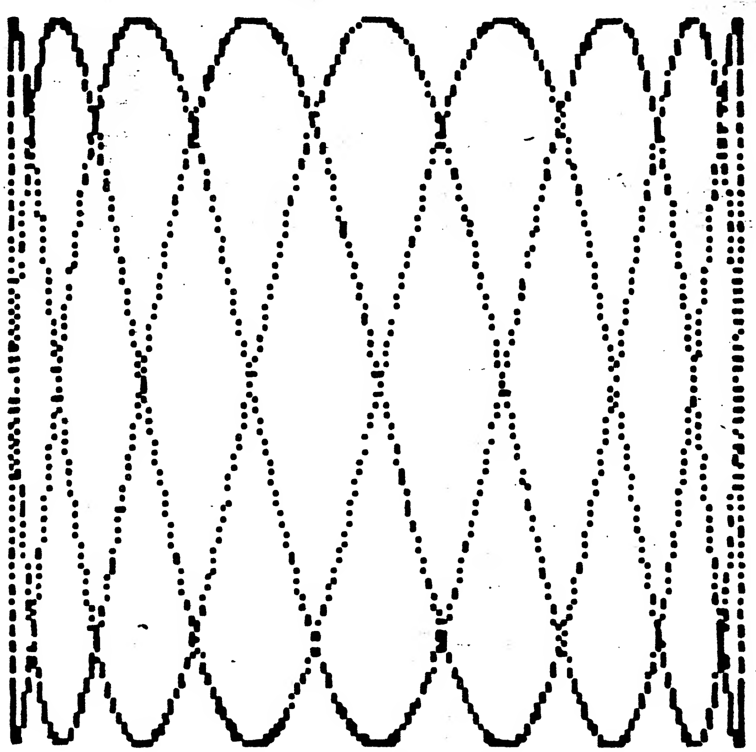

Fig. 1. Generating a Lissajous curve on the Atari.

Needless to say, as soon as I got home I programmed my 800 to plot Lissajous curves. (I had just eliminated the need to have a scope and frequency generators to experiment with Lissajous curves. This machine was opening doors for me!) The program was a success. I could plot the curves and observe the effects of changing various parameters. That was a key point—I got to play with a concept (in this case Lissajous curves) until I could command it, and I will not soon forget what I learned through my computer.

The curves the program was producing were visually pleasing so I added provisions to draw them at any screen position and size. This computer art was an unexpected bonus.

Plotting a Lissajous Curve

Lissajous curves are plots of the motion of a particle that is being acted on by two perpendicular simple harmonic motions. (I suggest consulting a physics book for a more in-depth explanation.) Thus, the coordinates of a point on a Lissajous curve can be expressed as:

$$x = A_x \cos(w_x t + dx)$$
$$y = A_y \cos(w_y t + dy)$$

A is the amplitude, w the angular speed, d a phase constant and t the time. These parameters make sense, but the best way to get a feel for them is to play around with them. This is where the Atari comes in.

The Lissajous curve plotting program is shown in Listing 1. It should run on any 16K Atari 400/800. The following comments explain what each section of the program does.

Lines 1–30: Initializations. Line 30 darkens the background for better screen contrast.

Lines 40–50: Inputs the parameters of the motion that effects the x-coordinates of the Lissajous curve.

Lines 60–70: Inputs the parameters of the motion that effects the y-coordinates of the Lissajous curve.

Line 72: Inputs the screen center of the curve to be drawn.

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Line 80: Inputs the dilation factor. If the scale would cause any out-of-bounds points, the program sets the scale to the maximum that will allow all the points to be plotted (lines 82–88).

Line 100: Input step. Step defines the smoothness of the plotted curve. The larger the step, the coarser the plot.

Line 120: Sets plot color.

Line 130: Plots the first point of the Lissajous curve (t=0) offset by the specified center point.

Line 140: Increases the time count by step.

Line 150: Draws a line to the next point on the curve.

Line 160: Keyboard check. If any key is hit the plot is halted. The space bar should be used. If not, the program will bomb later on.

Line 180: User is prompted. If answer is Y, the screen is cleared and new curve prompts are generated. If answer is "", then new curve prompts are generated (screen not cleared). Any other key stops the program.■

```
1   REM LISSAJ. PLOTTER BY TED MC FADDEN T.Q.R.
10  DEG:DIM A$(2)
20  GRAPHICS 8
30  SETCOLOR 2,0,0
40  PRINT"X:Amp,Omega,Phase";
50  INPUT AX,WX,PX
60   PRINT"Y:Amp,Omega,Phase";
70  INPUT AY,WY,PY
72  PRINT"Screen Center";: INPUT CX,CY
80  PRINT"Scale";: INPUT S
82  IF S*AX>CX THEN S=CX/AX
84  IF S*AX+CX>319 THEN S=(319-CX)/AX
86  IF S*AY>CY THEN S=CY/AY
88  IF S*AY+CY>159 THEN S=(159-CY)/AY
100 PRINT"Step";: INPUT T1
120 COLOR 1
130 PLOT S*AX*COS(PX)+CX,CY-S*AY*COS(PY)
140 T=T+T1
150 DRAWTO S*AX*COS(WX*T+PX)+CX,CY-S*AY*COS(WY*T+PY)
160 IF PEEK(764)=255 THEN 140
180 PRINT"READY.";: INPUT A$
190 IF A$="" THEN 40
200 IF A$(2,2)="Y" THEN 20
210 END
```

Listing 1. Lissajous curve plotting program for the 16K 400/800 Atari.

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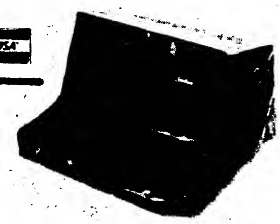

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Make Music With the Atari

It won't win you a Grammy Award, but with this chord organ program you'll begin to appreciate the music capability of the Atari.

By William L. Colsher

Syntax: SOUND *voice, note, tone, volume*

voice: Voice is an integer from 0 to 3 that selects the synthesizer voice to be turned on by this statement.

note: Note is an integer from 0 through 255 that tells the synthesizer what note to play. Higher numbers give lower notes. Table 2 lists some of these numbers and the musical notes they correspond to.

tone: Tone is an even integer from 0 through 14. A value of 10 gives a normal sounding note.

volume: Volume is an integer from 1 through 15. When more than one voice is being used the total volume should not exceed 32.

Table 1. Parameters of the Atari's Sound statement.

Just about every microcomputer has some kind of sound generator. The Apple II and Apple III have built-in speakers, as does the Hewlett-Packard HP-85. You can even make music of a sort by using the cassette port of a TRS-80. But none come close to the capabilities of the Atari 400 and 800. Built into each Atari is a four-voice synthesizer. Each voice is able to sound a single note at various volumes and with various tonal qualities, independent of the other three. The voices are controlled with the Sound statement, outlined in Table 1.

Since you can sound four separate notes at one time, you can play musical chords. This program shows one way of doing this.

A chord consists of at least three notes (all the chords used here have three notes). It would be tedious and inefficient to explicitly code all three notes of each of four chords for every one of the 12 notes of the scale. Fortunately, there is a definite relationship between the tonic, or main note of a chord, and the other notes. Therefore, you need only know the tonic and the type of chord to be played.

Table 3 shows the numerical relationships of the tonic to the other notes in the four chords I've chosen for this program. Once you know these relationships, it is a simple matter to write the program.

Conveniently, the Atari keyboard is 12 characters wide, not including control keys (A,S,D,F,G,H,J,K,L,;, + and * on the home row). You can read the Atari keyboard on the fly, but unfortunately the value returned is not the ASCII value of the character selected. Table 4 shows the values returned for each key used in this program, as well as the note or chord selected by that key. Lines 200 through 260 set up these relationships for the program.

Lines 1000 through 1120 are where the program spends most of its time. If no key has been pressed, the PEEK(764) statement returns a value of 255. After a keypress, you must reset that location to 255. This is done in line 1110 and the next to last state-

Note	Sound Number
A	144
B^b	136
B	128
C	121
C#	114
D	108
E^b	102
E	96
F	91
F#	85
G	81
A^b	76

Table 2. The Sound statement number corresponding to the notes of the octave starting with A below middle C.

Address correspondence to William L. Colsher, 1711 Robin Lane, Lisle, IL 60532.

Chord	Second Note Multiplyer	Third Note Multiplyer
Major	.79166	.66666
Seventh	.79166	.5625
Minor	.84027	.66666
Minor Seventh	.84027	.5625

Table 3. Multiplication factors of the tonic that produce the second and third notes of the various chords.

Key Pressed	PEEK(764)	Note or Chord Played
A	63	A
S	62	B♭
D	58	B
F	56	C
G	61	C#
H	57	D
J	1	E♭
K	5	E
L	0	F
:	2	F#
+	6	G
*	7	A♭
1	31	Major
2	30	Seventh
3	26	Minor
4	24	Minor Seventh

Table 4. Correspondence between the Atari's keys and the notes or type of chord produced in the PEEK (764) statement in line 1000 of Listing 1.

```
10 DIM REALTONE(12,2)
100 LASTBYTE=0
200 REM ***SET UP REAL NOTE ARRAY
210 FOR I=1 TO 12
220 READ A,B
230 REALTONE(I,1)=A:REALTONE(I,2)=B
240 NEXT I
250 DATA 63,144,62,136,58,128,56,121,61,114,57,108,1,102,5,96,0,91
260 DATA 2,85,6,81,7,76
1000 BYTE=PEEK(764):REM ***READ KEYBOARD
1010 IF BYTE=255 THEN GOTO 1000:REM ***NO KEY PRESSED
1020 IF BYTE=31 THEN GOTO 2000:REM ***MAJOR CHORD
1030 IF BYTE=30 THEN GOTO 2100:REM ***SEVENTH CHORD
1040 IF BYTE=26 THEN GOTO 2200:REM ***MINOR CHORD
1050 IF BYTE=24 THEN GOTO 2300:REM ***MONOR 7 CHORD
1060 REM ***CHECK FOR NOTE CHANGE
1070 IF BYTE=LASTBYTE THEN GOTO 1000
1075 LASTBYTE=BYTE
1080 FOR I=1 TO 12
1090 IF BYTE=REALTONE(I,1) THEN TONE=REALTONE(I,2)
1100 NEXT I
1110 POKE 764,255:REM ***RESET KEYBOARD
1120 GOTO 1000
2000 REM ***PLAY MAJOR CHORD
2010 SOUND 0,TONE,10,8
2020 SOUND 1,INT(TONE*0.79166+0.5),10,8
2030 SOUND 2,INT(TONE*0.66666+0.5),10,8
2040 POKE 764,255
2050 GOTO 1000
2100 REM ***SEVENTH CHORD
2110 SOUND 0,TONE,10,8
2120 SOUND 1,INT(TONE*0.79166+0.5),10,8
2130 SOUND 2,INT(TONE*0.5625+0.5),10,8
2140 POKE 764,255
2150 GOTO 1000
2200 REM ***MINOR CHORD
2210 SOUND 0,TONE,10,8
2220 SOUND 1,INT(TONE*0.84027+0.5),10,8
2230 SOUND 2,INT(TONE*0.66666+0.5),10,8
2240 POKE 764,255
2250 GOTO 1000
2300 REM ***MINOR 7 CHORD
2310 SOUND 0,TONE,10,8
2320 SOUND 1,INT(TONE*0.84027+0.5),10,8
2330 SOUND 2,INT(TONE*0.5625+0.5),10,8
2340 POKE 764,255
2350 GOTO 1000
```

Program listing. Chord organ program for the Atari.

ment of each of the chord-maker routines.

If a key has been pressed, the program checks first to see if it was a chord-select key (1 through 4). If so, it jumps to the appropriate routine and plays the selected chord using the last tone selected. This corresponds to the way chord names are written out. To play a D-minor chord you would first touch the H key to select a D note and then the 3 key to select a minor chord.

If the key pressed was not a chord-select key, the program examines its table of notes and key values (from Table 4) and, if the key value is found, sets the variable Tone to the corresponding value. This does not change any chord being played.

This program only begins to explore the musical abilities of the Atari. If you'll refer again to Table 1, you'll notice that there is a volume control parameter in the Sound function. Perhaps the up and down arrows on the keyboard could control that. You'll also notice that I've used only three of the four voices. A second "manual" could be added that plays single notes using the fourth voice. The tone parameter in Sound can produce some pretty weird noises—a rhythm section could be added using the fourth voice. Finally, you can always add more chords. ■

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